Universal behavior of baryons and mesons' transverse momentum distributions in the framework of percolation of strings.

L.Cunqueiro, J.Dias de Deus, E.G.Ferreiro and C.Pajares[1]

[1] IGFAE y Departamento de Física de Partículas, Universidade de Santiago de Compostela, 15782-Santiago de Compostela,Spain

The clustering of color sources[1] reduces the average multiplicity and enhances the average $< p_T >$ of an event in a factor $F(\eta)$ with respect to those resulting from pure superposition of strings :

$$< \mu >= N_s F(\eta) < \mu >_1, \; < p_T^2 >=< p_T^2 >_1 / F(\eta) \tag{1}$$

where N_S is the number of strings and $F(\eta) = \sqrt{\frac{1-e^{-\eta}}{\eta}}$ is a function of the density of strings η[2]. The invariant cross section can be written as a superposition of the transverse momentum distributions of each cluster, $f(x, p_T)$ (Schwinger formula for the decay of a cluster), weighted with the distribution of the different tension of the clusters, $W(x)$ ($W(x)$ is the gamma function whose width is proportional to $1/k$ where k is a determined function of η related to the measured dynamical transverse momentum and multiplicity fluctuations) [3, 4]:

$$\frac{dN}{dp_T^2 dy} = \int_0^\infty dx W(x) f(p_T, x) = \frac{dN}{dy} \frac{k-1}{k} \frac{1}{< p_T^2 >_{1i}} F(\eta) \frac{1}{(1 + \frac{F(\eta) p_T^2}{k < p_T^2 >_{1i}})^k}. \tag{2}$$

For (anti)baryons equation (1) must be changed to $< \mu_{\overline{B}} >= N_S^{1+\alpha} F(\eta_{\overline{B}}) < \mu_{1\overline{B}} >$ to take into account that baryons are enhanced over mesons in the fragmentation of a high density cluster. The parameter α =0.09 is fixed from the experimental dependence of $\frac{\overline{p}}{\pi}$ on N_{part}. The (anti)baryons probe higher densities than mesons, $\eta_B = N_S^\alpha \eta$. On the other hand, from the constituent counting rules applied to the high p_T behavior we deduce that for baryons $k_B = k(\eta_B)+1$. In fig 1., we show the ratios R_{CP} and $\frac{\overline{p}}{\pi^0}$ defined as usual, compared to RHIC experimental data for pions and antiprotons together with the LHC predictions. In fig.2 left we show the nuclear modification factor R_{AA} for pions and protons for central collisions at RHIC. LHC predictions are also shown. We note that pp collisions at LHC energies will reach enough string density for nuclear like effects to occur. In this respect, in fig.2 , right, we show the ratio R_{CP} for $pp \to \pi X$ as a function of p_T, where the denominator is given by the minimum bias inclusive cross section and the numerator is the inclusive cross section corresponding to events with twice multiplicity than minimum bias. According to our formula (2) a suppression at large p_T occurs.

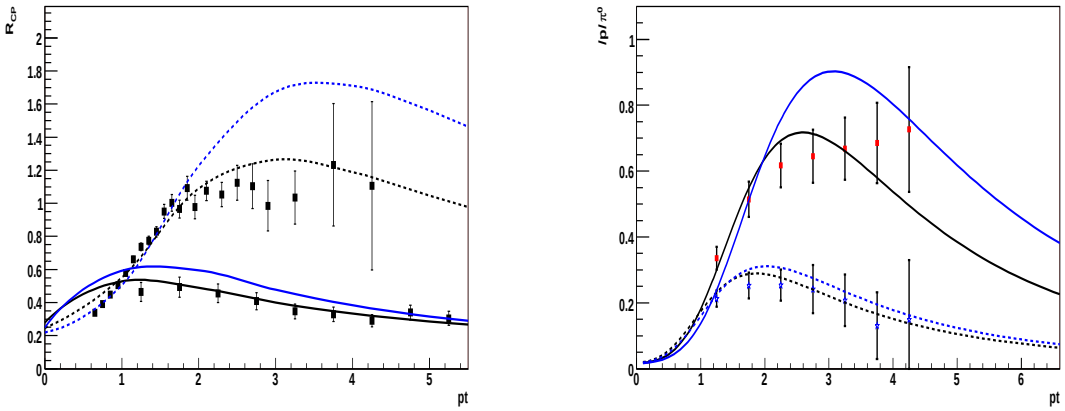

Figure 1. Left: R_{CP} for neutral pions (solid) and antiprotons (dashed). Right: $\overline{p}$ to π^0 ratio for the centrality bins 0-10% (solid) and 60-92% (dashed). RHIC results in black and LHC predictions in blue.

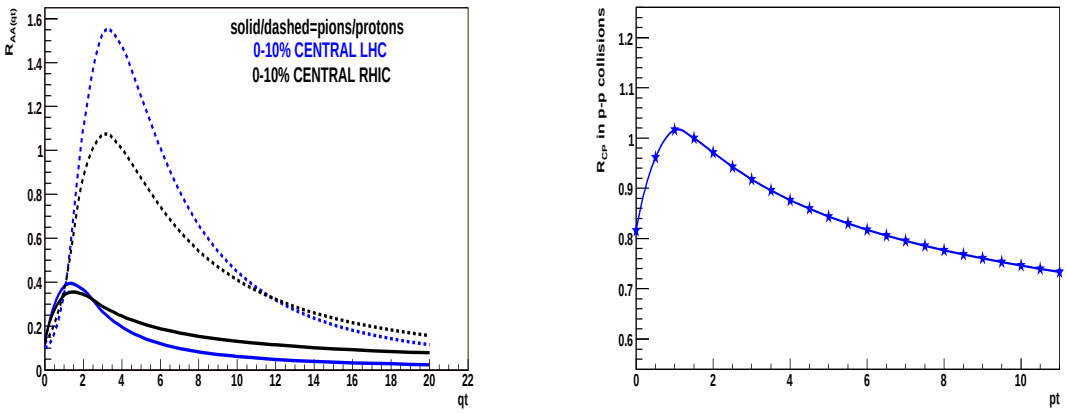

Figure 2. Left: Nuclear Modification Factor for π^0 (solid) and $\overline{p}$ (dashed) for 0-10% central events, RHIC results in black and LHC predictions in blue. Right: R_{CP} for pions in p-p collisions at LHC.

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References

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